BRITTAN'S TABLES OF CHEMICAL ANALYSIS


25

TABLES

OF

ANALYSIS

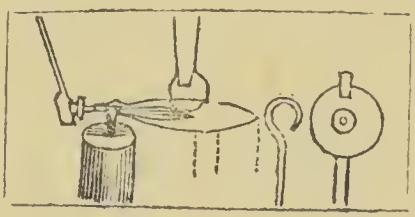
IN THE MOIST WAY, AND BY THE BLOWPIPE;

TOGETHER WITH

THE CHEMICAL SYMBOLS AND EQUIVALENTS,

BY

EDWARD BRITTAN.



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TO

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GERMAN PHARMACEUTICAL SOCIETY.
ETC. ETC. ETC.

THESE TABLES,

THE FIRST FRUITS OF HIS INSTRUCTIONS,

ARE RESPECTFULLY DEDICATED BY

EDWARD BRITTAN.

TABLE I.

Character of substance. 1. A *Base* combined with an *Acid*, or a *Metal* with a *non-metallic* Body, each being in this List. 2. *Soluble* in *Water*.

OPERATIONS TO FIND THE BASE OR METAL.

1st. Acidulate a Concentrated Solution with HCl, unless AgO or HgO, or much PbO be present, which is known by the HCl producing a *White Precipitate*, in which case use NO_5^2.

2nd. Add H S.

Are precipitated by HS from an acid solution.

Sb_2O_3	**Orange**	In a closed tube with NaO+Fo, or Black Flux, this precip. gives a metallic sublimate and garlic odour. If the
As_2O_3	**Yellow**	As be in the compound, as As_2O_5, the precipitate forms very slowly, and generally requires to be hastened by boiling.
Cd O	——,——	NH_3+HS, with a *neutral* solution, gives a *yellow* precip. INSOLUBLE in excess.
$Sn O_2$	——,——	——,——,——,—— SOLUBLE in excess.
Pl O	**Brown**	A solution of this substance gives a deep crimson with KI, and is precipitated in a metallic form by a slip of Zn.
Sn O	**Dk Brown**	Au Cl_3 gives a *purple* precipitate.
Bi O	——,——	HO in excess throws down, from a concentrated solution, a *white milky* subsalt.
Au_2O_3	**Black**	FeO+SO_3 gives a *brown* precip. recognised, when deposited, as *metallic Gold*. Sn Cl gives a *purple* precip.
Hg O	——,——	KO in very minute quantity, gives a *brown* precip.; in excess, a *yellow* precip.
Hg_2 O	——,——	HCl gives a *white* precip. insoluble in excess of water. NH_3 gives a *black* or *grey* precip. INSOLUBLE in excess.
Ag O	——,——	NH_3 gives a *brown* precip. SOLUBLE in excess, or if acid, no precip.
Cu O	——,——	NH_3 gives a *blue* precip.; in excess a *purple* solution.
Pb O	——,——	SO_3, or its salts, give a *white* precipitate, which is *blackened* by NH_3+HS.
Fe_2O_3	**Mlk white**	This milky precip. is not a *metallic* Sulphuret; it is *Sulphur*.

3rd. In case HS gives no Precipitate from an *Acid* Solution, *neutralize* with NH_3, and add NH_3+HS.

NH_3+HS from solution.

Fe O	**Black**	KO+CO_2, or NaO+CO_2, gives a precip. first *white*, which turns, 2nd, *green*, 3rd, *brownish-red*.
Ni O	——,——	——,——,——,—— *apple green*.
Co O	——,——	——,——,——,—— *pinkish-red* precip., which on boiling, becomes *blue*.

Al **O**	precip. a	—— „ ——	—, —— „ ——	INSOLUBLE in excess, which is pure *Alumina*.
Mn **O**		**Flesh Red**		

4th. In case HS gives no Precipitate from the *Acid* Solution, or NH_3+HS from a *Neutral* one, add a solution of KO+CO_2.

Mg **O**	not precipd. by HS at all but precipd. by KO+CO_2	**White**	NH_3 gives a *white* precip. from a *neutral* solution.
Ca **O**		—— „ ——	SO_3, or better KO+SO_3, gives a *crystalline* precip., *after a time*.
Ba **O**		—— „ ——	—„—— „— an *immediate precip.* Silicated Fluoric Acid gives, after a time, a *gelatinous* precip.
Sr **O**		—— „ ——	—„—— „—— „—— ——„——gives no precipitate.

5th. In case of no Precipitate from the HS, or the NH_3+HS, or the KO+CO_2, the Base is the following :—

N **H**$_3$	not prec. by HS or by KO+CO_2, at all	——	KO, in a strong solution, evolves NH_3, which forms *white fumes* with HCl, held to it on a glass rod.
K **O**		——	Pl Cl_2 in Alcohol, gives a *yellow* precip.
Na **O**		——	There being no precip., proves it to be Na O. Before the Blow-pipe it yields a strong yellow flame.

OPERATIONS TO FIND THE ACID OR NON-METALLIC BODY.

1st. To a portion of the dissolved Compound, add HCl.

C **O**$_2$	effervesces with H Cl and yields	**A Gas**	Inodorous.
S with a metal.		— „ —	Fœtid.

2nd. If the HCl produce no effervescence, add to a concentrated *neutral* Solution, Ba Cl in Solution.

S **O**$_3$	precipd. by Ba Cl.	**White**	*Free Acid* (HCl the best) does not dissolve the precip.
B **O**$_3$		— „ —	Add a few drops of SO_3, and some *Alcohol* ; it burns with a *green* flame.
F with a metal.		— „ —	Heated in a crucible with SO_3, it *etches* characters drawn on waxed glass.
As$_2$ **O**$_5$		— „ —	BO$_3$ and F being absent, dissolve the compound in an acid : add HS and boil—it yields a *yellow* precip.
P$_2$ **O**$_5$		— „ —	If all the other acids are absent, P_2O_5 must be present. For further particulars see *Table V*.

3rd. If the HCl produce no effervescence, and the BaCl no precipitate, add AgO+NO_5.

Cl	prec. by AgO+NO_5	**White**	Insoluble in dilute NO_5.
N **O**$_5$	not prec. by AgO+NO_5	——	Deflagrates on C before the Blow-pipe ; in solution with SO_3 and some grains of Cu, it yields red fumes of NO_4.

TABLE II.

Character of Substance. { 1. A *Base* combined with an *Acid*, or a *Metal* with a *non-metallic* Body, each being one in these Tables.
2. *Soluble*, or *sparingly Soluble* in *Water*. Soluble in HCl or NO_5.

OPERATIONS TO FIND THE BASE OR METAL.

1st. Dissolve the Compound in diluted HCl (with heat, if necessary) unless AgO or HgO_2, or much PbO is present, in which case use NO_5

2nd. Dilute the *Acid* Solution with HO, add excess of HS, and proceed exactly *as in Table I.*

It is, however possible that

Sr, Ba, Ca, Mg (may be combined with BO_3 or F.) — In which case they are precip. from the Acid Soln. on neutralizing it with NH_3 by the 3rd operation of Table I. — **White** ——„—— ——„—— ——„—— — These may be known from each other as well as from the white prec. of Al O and Zn O likewise thrown down by NH_3 in the fol. way

SO_3 or its salts give in very dilute solutions. — an immediate white precipitate, — Sil. Flu. Acid gives, after a time, a gelatinous precip.

—„——„——„——„—— no precipitate.

If Ba and Sr are absent, saturate with NH_3 adding a soln of NH_4 Cl, an *oxalate* will now give a *white* precip.

If no precip. is produced by the *oxalate*, add $NaO+PO_{2\,5}$, which gives, in an *alkaline* soln a *white* precip.

OPERATIONS TO FIND THE ACID OR NON-METALLIC BODY.

1st. Moisten the dry Salt (first pounded) with HCl.

C, O_2, S — effervesces with HCl. and yields — **A Gas** ——„—— — Inodorous. Fœtid.

N, O_5 — ——— Blow-pipe—in a solid state, deflagrates on C. In solution with SO_3 and some grains of Cu, yields brown fumes of NO_4

As_2, O_5 — ——— Blow-pipe—with NaO on C, gives a *garlic* odour. With C and BO_3 in a closed tube sublimes *metallic* As.

2nd. Mix the Compound with SO_3 in a platinum crucible, and heat.

F — produces with SO_3 when heated — **A Gas** — This Gas *etches* characters drawn on *waxed glass.*

B, O_3 — ——— ——— With some SO_3 and *Alcohol* it burns with a *green* flame.

3rd. Dissolve a portion of the Compound in NO_5 (if possible, without heat,) add a solution of $AgO+NO_5$.

Cl — prec. by $AgO+NO_5$ — **White** — Insoluble in dilute NO_5.

4th. Heat a portion of the Compound in NO_5; after *brown fumes* arising, and *yellow* precip. of *Sulphur* being deposited, dilute with HO, and add $BaO+NO_5$

5th. A dilute solution of the Compound in HCl is tested with BaCl.

{S O$_3$} precip. by BaCl { **White** } Insoluble in excess of *Acid*.

{P$_2$ O$_5$} In the absence of the other *Acids* the Compound must contain P$_2$ O$_5$. For further particulars see *Table V*.

TABLE III.

Character of Substance. 1. A *Base* combined with a *Metal*, or a *Metal* with a *non-metallic* Body, each being a substance in these Tables. 2. *Insoluble*, or very *sparingly soluble* in *Water* or *Acids*—these Compounds can only be as under.

OPERATIONS.

1st. Powder the Compound, and treat it with NH$_3$+HS.

PbO SO$_3$	moistened with NH$_3$+HS, these change from their natural white color to	**Black**	The substance heated in a closed tube *remains unaltered*.	Heated with NaO+$\overline{Fo}$, or Black Flux, it	yields a metallic button, which is soft.
Ag Cl	,,	,,	,, *fuzes*.	,,	yields a button of metallic silver.*
Hg$_2$ Cl	,,	,,	,, *sublimes*.	,,	yields a sublimate of metallic mercury.
CaO SO$_3$	moistened with NH$_3$+HS, these remain with color.	**Unchgd.**	Boil the powdered substance in HO.—Filter, divide the clear liquor and test one part with Ba Cl, and the other with NH$_3$+$\overline{Ox}$ They both give *white* precipitates, the first being insoluble in Acids.		
SrO SO$_3$	,,	,,	See Operation 2nd.		
BaO SO$_3$	,,	,,			

* Although the natural color of Ag Cl is white, yet it is sometimes turned of a deep violet, by light, and if fused, is of a yellowish color.

2nd. If nothing has been dissolved by boiling in HO, boil the powdered substance with NaO+CO$_2$, or KO+CO$_2$ filter; *supersaturate* with HCl, and test with BaCl.

SrO SO$_3$	thus treated yields	**Insol prec.**	Concentrate the *supersaturated* Liquor, add Alcohol, and inflame.--It burns with a rich *crimson* flame.
BaO SO$_3$		— ,, —	Test the *suprsaturated* Liquor with Silicd. Fluoric Acid, which, after a time, gives a *gelatinous* precip.

3rd. In case of no result from the former processes, powder and boil the Compound in concentrated SO$_3$.

Acid Phosphates	These are decomposed only by boiling in concentrd. SO$_3$; &unless the Base be Ba or Sr, or Ca, or PbO, they then become soluble in HO, & belong to Table 1.	Blow-pipe—moisten with SO$_3$, and it gives a *greenish* color to the flame. See also PO$_{2\ 5}$ in *Table V*
Acid Arseniates		Heat in a closed tube with NaO+$\overline{Fo}$ or Blaek Flux, aud it gives a metallic sublimate and garlic odour.

TABLE IV.

Character of substance. { 1. *Mixed* Compounds, or such as being more simply constituted, consist only of a *Base* and an *Acid*.
2. Easily soluble in Water.

OPERATIONS TO FIND THE BASE OR METAL.

1st. Acidulate a Concentrated Solution with HCl, unless AgO or HgO_2, or much PbO be present, which is known by the HCl producing a *White Precipitate*, in which case use NO_5.

2nd. Add H S.

Sb O_3	A Precip.	Orange	The *slightly* Acid Soln. of this Salt, with excess of HO, becomes milky. Blow-pipe—mix with $NaO+CO_2$ and reduce, the bead is very long cooling, gives a thick smoke, & becomes covered with a network of fine crystals.
As O_3	,,	Yellow	Blow-pipe—heated with $NaO+Fo$, or Black Flux in a closed tube, it yields a *sublimate* of *metallic* arsenic, & a *garlic* odour.
Sn O_2	,,	,,	Blow-pipe—mix with $NaO+CO_2$ & reduce—the bead *flattens* with the hammer. This Salt, added to a *bead* of *Microcosm. Salt* and *copper*, destroys its green. and gives an opaque brownish-red.
Pt O	,,	Brown	A solution of this substance gives a deep crimson with KI, and is precipd. in a metallic form by a slip of Zinc.
Sn O	,,	Dk Brown	With great excess of HO this becomes *milky*,—AuCl produces a *purple* precipitate. (brown metallic Gold.
Au O	,,	Black	Sn Cl, cleared by a little HCl, gives, with a very dilute solution of the Salt, a reddish purple precip. $FeO+SO_3$ throws down
Hg O	,,	,,	Therefore to find has any thing been dissolved, digest the precip. with NH+HS, filter, dilute, and mix the liquor with HCl: if only a milkiness arise from free sulphur, & no metal sulphuret appears, then nothing has been dissolved by the NH+HS; or else heat a few drops of the filtered liquid on platinum foil, to redness—if nothing remains—nothing has been dissolved.
Hg_2 O	,,	,,	
Ag O	,,	,,	
Cu O	,,	,,	
Bi O	,,	,,	
Pb O	,,	,,	
Cd O	,,	,,	
Fe O_3	Milk white Precip. of Sulphr.	Black	Sn Cl, cleared by a little HCl, gives, with a very dilute solution of the Salt, a reddish purple precip. $FeO+SO_3$ throws down Cd in small grey glancing spangles.

Those are all precipitated by HS; especially if warmed, and give Allow the precip. to settle, pour off the Solution, add to the precipitate, first a little HCl, and then NH+HS in excess.

These are partially or altogether *insoluble* in NH+HS.

Dilute the solution of the precip. with HO, acidulate with HCl, which precipitate the Sulphuret.

These colors are rendered thin small from a portion of precipitated Sulphur.

These fully *dissolve* in the NH+HS

To the precipd. sulphuret, which is insoluble in NH+HS, add pure NO_5 and heat—the metal becomes oxidized and dissolved, and the sulphur precipd., of a *yellow* color—then filter from the insoluble sulphur. HgS, alone, is an exception, as it is not dissolved by the NO_5 unless this be too strong but remains of its characteristic black color.

{ Blow-pipe } In a close tube this HgS *sublimes, unaltered*.
{ Blow-pipe } In close tube this HgS *sublimes, mixed* with metallic mercury.

HCl gives, with a solution of the substance, a *white* precip, insoluble in dilute NO_5 but soluble in NH.

NH in excess, with a solution of this substance, gives a *purple* solution.

Concentrate to get rid of NO_5 and add HO, which, in excess, produces a *milkiness*.

SO_3 with a solution of the substance, gives a *white* precip. blackened by NH+HS.

Blow-pipe—heated with $NaO+CO_2$ on C, it bedecks the C with a *reddish brown powder*. A bar of *tin* precipitates metallic

In case of these first 3 metals being together in the precip., it is sometimes difficult to discriminate them. In such dry and heat the precip. in a closed glass tube, without access of air—the S and AsS will sublime, leaving the Sn and Sb at the bottom; dissolve this remainder in HCl, and dilute with HO, when AuCl instantly detects the Sn, by its purple precip

3rd. Some drops of the liquid obtained by filtration from the first precipitate (by HS from an *Acid Solution*) or some drops of the solution, if no precipitate was then obtained, are heated to redness on platinum foil, for fixed bases, as in the preceding operation.

4th. If a remainder or fixed Base be present, supersaturate the liquor with NH, and add NH+HS.

Ni O	Black	Blue Solution	Mix the digested HCl solution of the first precip. thrown down by NH+HS with
Co O	,,	Rose Red ,,	
Zn O	White	A Solution	

Wash the precipitate with exceedingly diluted NH+HS, mix both the prec. and filter with HCl, and

Apple Grn Prec.
Blue Precip. Turning Green.
,,

This precipitate, before the Blow-pipe, gives an intense *blue* to *Borax*, or to *Microcosmic Salt*.

Filter, and add NH_3+HS which if Zn be present, gives a precip., which, moistened with $CoO+NO_5$, gives a fine green flame, & heated on C. spreads a coat of white oxide around.

Cd O	These ar[e]	——„——	Allow [the] prec[ip.]	These [to]gether,	platinum foil, to redness—if NO_5 [...] nothing remains—nothing has been dissolved.	[...] but remains of its characteristic black color.	Blow-pipe—heated [...] Cd in small grey glancing spangles.
Fe_2O_3		Mlk white (Precip. of Sulphr.)					

3rd. Some drops of the liquid obtained by filtration from the first precipitate (by HS from an *Acid Solution*) or some drops of the solution, if no precipitate was then obtained, are heated to redness on platinum foil, for fixed bases, as in the preceding operation.

4th. If a remainder or fixed Base be present, supersaturate the liquor with NH_3, and add NH_3+HS.

These are precipd. from an alkaline solution, by NH_3+HS:

Base	Precip.		Result		Further test	Observations
Ni O	Black	Wash the precipitate with exceedingly diluted NH_3+HS, mix both the prec. and filter with HCl, and digest until it cease to smell of HS, & is dissolved* filter and heat with NO_5, then add excess of NH_3 to this acid solution, and you will have	Blue Solution	Mix the digested HCl solution of the first precip. thrown down by NH_3+HS with KO	Apple Grn Prec.	
Co O	——„——		Rose Red „		Blue Precip: Turning Green.	This precipitate, before the Blow-pipe, gives an intense *blue* to *Borax*, or to *Microcosmic Salt*.
Zn O	White		A Solution		——„——	Filter, and add NH_3+HS which if Zn be present, gives a precip., which, moistened with $CoO+NO_5$ gives a fine green flame, & heated on C, spreads a coat of white oxide around.
Mn O	Flesh Red		A Precipitate Changing to Brown		Prec. chng. to Brn	Blow-pipe—the smallest portion of Mn gives a green color to a bead of Soda.
Al_2O_3	White		White Precip.	Soluble in KO, and precipd. again by NH_4+Cl. Bl-pipe—moistd. with $CoO+NO_5$, gives by day a *blue*, & by night a *dirty violet* color to the assay.		
Fe_2O_3	Black	*If HCl does not fully dissolve it, add some NO_5.	Red or Brn Prec.	If the Precip. be brown. Alumina may be present, therefore digest the filter and contents in HCl, filter and add KO in excess—the AlO is dissolved and the FeO_{23} precipd.—the soln. is then tested with NH_4+Cl, for AlO, and if present, a white precip. will result. If the Iron was as FeO, a solution of the salt will precip. metallic gold, from a solution of $AuCl_3$.		
Fe O	——„——		——„——			

5th. Try the solution obtained from the precipitate thrown down by NH_3+HS, on platinum foil, for fixed Bases, as directed in process No. 3, if any be present.

6th. Supersaturate with HCl, heat until the mixture gives no smell of HS, filter it from the free sulphur, add excess of NH_3+CO_2, and gently warm.

Precipd. by NH_3+CO_2:

Base	Precip.						
Ca O	White	Dissolve this prec. in HCl & add dilute SO_3 or better $3KO+SO_3$ which ylds.	A prec. after some time	In case of an immediate precipitate, the *three earths* may be present, therefore mix a portion of the dilute HCl soln. with dilute SO and warm, filter the precip., supersat. the soln. with NH_3 & test with $\overline{Ox}$, or with an oxalate, which gives	White prec.	The precip. produced by the SO_3 containing Sr or Ba, or perhaps both, is heated on C for a long time in the *inner* flame of the Blow-pipe—the mass produced is dissolved in a few drops of HCl & evaporated to dryness—it is then inflamed on a slip of paper, wet with Alcohol, and if Sr be present, a crimson flame is produced at the point of contact.	To find if BaO is also present, test the HCl soln. with Sild. Fluor. Acid if no precip. appears aft. some time, Ba is absent
Ba O	——„——		——„——immediately		no prec.		
Sr O	——„——		——„——————„——		——„——		

7th. When Ca, Sr, and Ba, have been precipitated by NH_3+CO_2 the solution may still contain Mg, Na, and K, therefore examine for fixed Bases, as in operation 3.

8th. In case of fixed remainder, add solution of $NaO+PO_{25}$

{Mg O} $NaO+PO_{25}$ produces {White precip.}

9th. In case of no precip. evaporate to dryness, and heat to redness, until all the Salts of NH_3 are volatilized—dissolve in a small quantity of HO, add Alcohol, and treat with $PlCl_2$

Gives with $PtCl_2$ a

Base	Precip.	Observations
K O	Bt. Yel. Prec.	Blow-pipe—the Compound gives a violet color to the outer flame, if KO alone is present.
Na O	no precip,	——„——————„——————strong yellow——„——
NH_3	——„——	Add excess of KO to the solution of the substance, and heat.—Moistened turmeric paper turns brown, or a rod moist with HCl forms white vapours.

OPERATIONS TO FIND THE ACID OR NON-METALLIC BODY.

1st. To a portion of the dissolved Compound, add HCl.

effervesces with H Cl and yields

Body	Result	Observations
C O_2	A Gas	Inodorous.
S	—— „ ——	Fœtid. To detect CO_2 mixed with the HS, see below Operation 2.

2nd. If the HCl produce no effervescence, add to a concentrated *neutral* Solution, Ba Cl, unless AgO, or Hg_2O, or PbO be present, which is known by the HCl producing a white precip., in which case add $BaO+NO_5$.

precd. by BaCl or $BaO+NO_5$

Body	Precip.	Observations
C O_2	White	HCl or NO_5, with effervescence, dissolves the precip., which does not re-appear when the moderately acid solution is boiled and saturated with NH_3—but if the precip. does re-appear, then [CO_2 is present, in company with one of the Acids below.
S O_3	—— „ ——	Insoluble in HCl or NO_5.
B O_3	—— „ ——	Add a few drops of SO_3 and some *Alcohol*; it burns with a *green* flame.
F	—— „ ——	Heated in a crucible with SO_3 it *etches* characters drawn on waxed glass.
As_2O_5	—— „ ——	Dissolve the compound in an *Acid*, add HS and boil—it yields a *yellow* precip. Heated in a close tube with $NaO+\overline{Fo}$, or Black Flux, it gives a metallic sublimate and garlic odour.
P_2O_5	—— „ ——	If AsO_{25} and BO_3 and F are absent, test the soln. of the substance with BaCl, and a precip. is produced, which disappears on the addition of HCl or NO_5 and re-appears when the acid is saturated with NH_3, but if AsO_{25} or F is present, they must be first separated—AsO_{25} by HS, and F by boiling in SO_3 as long as it yields vapours—the SO_3 is then thrown down by BaCl, and on the filtered liquor being neutralized with NH_3, a precip. is produced, if by BO_3 it is soluble in excess of HO, but if by PO_{25} it is not so.

3rd. If the HCl produce no effervescence, and the BaCl no precipitate, add $AgO+NO_5$.

Body		Precip.	Observations
Cl	prec. by $AgO+NO_5$	White	Insoluble in dilute NO_5.
N O_5	not prec. by $AgO+NO_5$	————	Deflagrates on C before the Blow-pipe: in solution with SO_3 and some grains of Cu, it yields red fumes of NO_4

TABLE V.

Character of Substance. { 1. Mixed compounds totally insoluble or only partly soluble in water. 2. Compleatly soluble in NO_5 or HCl.

OPERATIONS TO FIND THE BASE OR METAL.

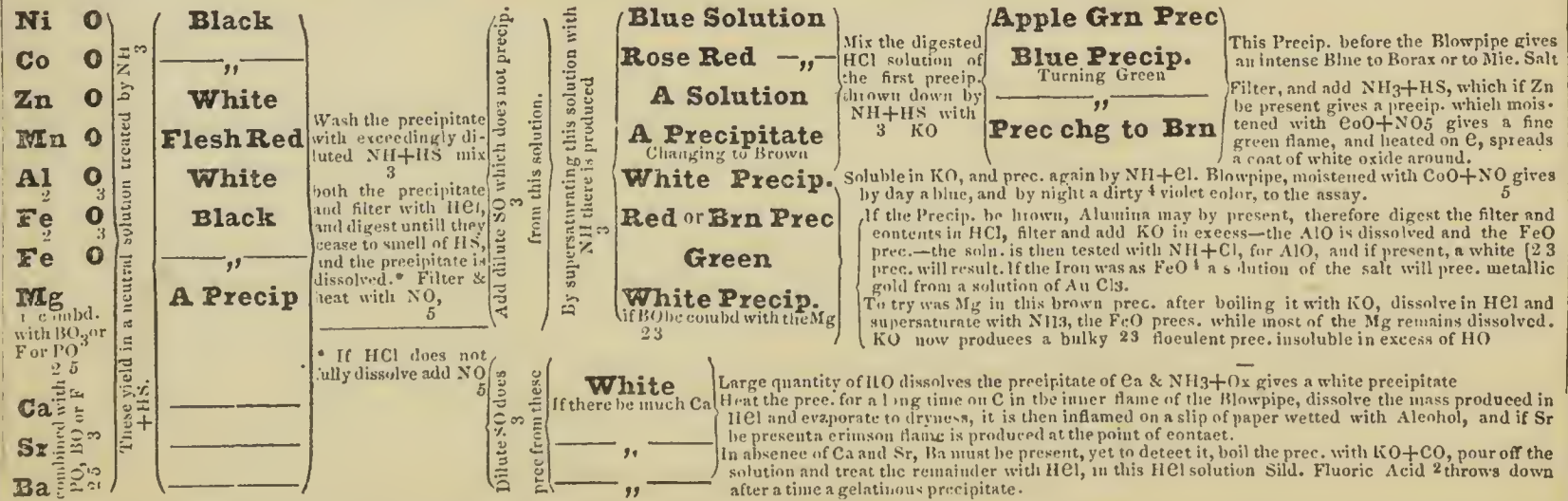
1st. Treat the compound with water, if any portion is dissolved, examine this solution as directed in *Table IV.*

2nd. Dissolve the remainder (insoluble in water) in HCl, unless AgO or HgO_2 or much PbO be present, which is known by the HCl producing a white precip. in which case use NO_5

3rd. Proceed exactly as in Operation 2nd. of *Table* 4, by adding HS, &c., &c., &c.

4th. After proceeding as directed in Operation 2nd. of *Table IV*, some drops of the liquid obtained by filtration from the first precipitates, (by HS from an acid solution) or some drops of the solution, if no precipitate was then obtained, are heated to redness on platinum foil for fixed Bases, as in the proceeding operation.

5th. If a remainder or fixed base be present, supersaturate the liquid with NH_3, and add $NH+HS$.



6th. Try the solution filtered from the precipitates obtained by NH_3+HS for fixed bases, as required in operation 6th of *Table IV*, and in testing for Ca, Sr, Ba, Mg, K, Na, and NH_3, proceed according to the directions laid down in that table, it being *almost* needless to test for Alkalies, as all the acids here noticed form Soluble Salts with them.

OPERATIONS TO DETECT THE ACID OR NON-METALLIC BODY.

1st. On the powdered compound pour HCl.

NH_3 and protected from the air, if a white precipitate results, which is soluble in HCl with *effervescence*, then CO_2 is mixed with the S

2nd. Dissolve a portion of the compound in HCl, unless AgO or Hg_2O or PbO are present, in which case use NO_5, dilute with HO and add BaCl, or if NO_5 was the solvent, add $BaO+NO_5$.

{**S** **O_3**} Prec by Ba Cl or $BaO+NO_5$ } **White** } *Insoluble* in excess of *acid*.

3rd. Boil some of the compound in NO_5

{**S** } Yellow flocks of S are deposited } *Brown Vapours* are given off and the filtered liquor yields a *white* precipitate with $BaO+NO_5$

4th. Dissolve a portion of the compound in NO_5, if possible, without heat, dilute with HO, and test with $AgO+NO_5$.

{**Cl** } Precipitated by $AgO+NO_5$ { **White** } Soluble in NH_3

5th. Heat some of the compound with SO_3 in a platinum vessel.

{**F** } Heated with SO_3 yields { **A Gas** } Which *corrodes glass*

6th. Mingle some of the compound with SO_3 and add Alcohol, which is then to be inflamed.

{**B** **O_3**} Burns with a {**Green Flame**} Mixed with a Flux, of one part of CaF and 4½ parts $KO+2\,SO_3$, moistened with HO, and held on platinum wire in the inner Blow-pipe flame, it gives, shortly after fusion, a *green flame*, which soon disappears.

7th. Heat a portion of the compound on C before the Blow-pipe.

{**N** **O_5**} With heat { **Deflagrates** } The Salt heated with SO_3 yields *brown vapours* when scraps of copper are added

8th. Heat some of the compound with $NaO+CO_2$ on C before the Blow-pipe.

{**As**, **O_5**} Heated with $NaO+CO_2$ {**Gives a Garlic Odour**} Mingled with C and BO_3 and heated in a close tube it sublimes *metallic arsenic*.

9th. Moisten a small portion of the compound with SO_3 and with the platinum forceps, hold it in the inner Blow-pipe flame, in which case

{**P_2** **O_5**} Thus heated gives {**A Green Color to the outer Flames**}

This takes place, however, only in some cases, and BO_3 must be absent.—Fuse the Phosphate with excess of $NaO+CO_2$ dissolve in HO and it gives a yellow precipitate with $AgO+NO_5$ and a *blue* precipitate with $FeO+SO_3$ or place a grain of *Potassium* at the end of a glass tube, and 1-50 of a grain of the dry *phosphate* upon it, carefully heat to ignition and then remove the *excess* of K by amalgamating it with a little Hg, moisten the mass by gently blowing on it through a fine tube, and the mass will *smell* strongly of *Phosphuretted Hydrogen* Gas; or else, fuse the substance on C with BO_3 and when the intumescence is over thrust a fine *iron wire* through the bead, so that its two ends project, the whole is then heated in the inner blowpipe flame; when cold, the bead is crushed and a round grain of FeP is found, which is *Brittle Magnetic* and of *metallic appearance*.

TABLE VI.

Character of Substance. { 1. Mixed Compounds totally, or in great part insoluble, both in Water and dilute HCl, or NO_5.
2. If the Compound treated with Water, and then with dilute Acids, still leaves an insoluble remainder, it can only consist of the following, therefore

1st. Heat strongly in close tube.

Ba O+SO$_3$
Sr O+SO$_3$
Ca O+SO$_3$ } These are not sublimed.
Pb O+SO$_3$
Ag+Cl

Hg+Cl } Sublimed in close tube, without alteration—NH_3 turns it black.
Hg+S } Do. Do. the sublimate becomes red by scratching } If these are accompanied by any other free base, or a metal, the sublimate will exhibit little globules of Hg.

2nd. The part that does not volatilize is fused with thrice its weight of dry $NaO+CO_2$, and when cool, is dissolved slowly in Water, and when digested, is filtered from the insoluble remainder, and supersaturated with NO_5, then $BaO+NO_5$ is added.

S O$_3$ } $BaO+NO_5$ gives { **White Prec.** } Insoluble in dilute HCl or NO_5.

3rd. To another portion of the solution, supersatured with NO_5 add $AgO+NO_5$.

Ag Cl } $AgO+NO_5$ gives { **White prec.** } Insoluble in dilute NO_5.

4th. The undissolved portions now contain $BaO+CO_2$, or $SrO+CO_2$, or $CaO+CO_2$, or $PbO+CO_2$, or, perhaps, some metallic Ag, therefore dissolve these portions in NO_5 and test with HCl.

Ag } HCl gives { **White prec.** } Insoluble in dilute NO_5.

5th. Filter and mix the clear solution with NH_3.

Pb O } preed. by NH_3 { **White** }

6th. If AgO, or PbO are found in the solution, add excess of HS, in order to throw them down, filter, and as the solution then contains Ba, Sr, or Ca, add Silicated Fluoric Acid.

Ba O } Sil. Fluor. Acid gives after a time { **A prec.** } Which is gelatinous.

7th. Filter and add $KO+SO_3$, or very dilute SO_3.

Sr O } with SO_3 { An immediate **prec.** / After a time .. } The filtered liqour, saturated with NH_3, gives with $\overline{Ox}$ or an oxalate, a white precip.
Ca O }

HO or Acids—in such cases mostly

As_2O_5 } Can be detected by the Blow-pipe { Mingled with C and BO in a glass tube it sublimes metallic arsenic.
P_2O_5 } { Moistened with SO_3, and held in the inner flame with the platinum forceps, it gives a green color to the outer flame.—[see also P_2O_5 in Table V.

If by the Blow-pipe As_2O_5 or P_2O_5 have been deteeted—the powdered substanee must be boiled a long time with eoneentd. SO_3 in a platinum crucible—it is thereby decomposed and dissolved on adding HO—the solution may then be examined according to the method deseribed in Table V.

The Bodies whieh eannot be dissolved even by this method are PbO, CaO, SrO, and BaO.

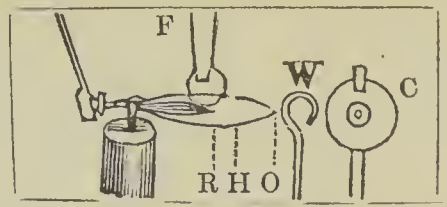
Bodies which contain SILICA are generally insolublc in Water and in Aeids. To deteet Silica, the substanee is to be fused with three time its weight of $NaO+CO_2$ and the mass dissolved in dilute HCl. If the Silica is in quantity, it *gelatinizes*, but if not the liquor is to be evapord. to dryness, and the mass re-dissolved in Water, when the Silica remains as white gritty powder. Before the Blow-pipe Silica is known by fusing with $NaO+CO^2$ into a colorless bead, and by giving with Mierocosmic Salt a colorless bead with infusible white speeks.

TABLE OF SYMBOLS AND EQUIVALENTS.

Symbols.	Elements.	Equivt. H=1	Symbols.	Elements.	Equivt. H=1	Symbols.	Elements.	Equivt. H=1	Symbols.	Elements.	Equivt. H=1
Al	Aluminum	13,7	**Ta**	Columbium (Tantalum)	184,90	**Mn**	Manganese	27,72	**Ag**	Silver (Argentum)	108,3
Sb	Antimony (Stibium)	129,2				**Hg**	Mercury (Hydrarg.)	101,43	**Na**	Sodium (Natrium)	23,31
As	Arsenic	75,34	**Cu**	Copper(Cuprum)	31,71	**Mo**	Molybdenum	47,96	**Sr**	Strontium	43,85
Ba	Barium	68,66	**F**	Fluorine	18,74	**Ni**	Nickel	29,62	**S**	Sulphur	16,12
Bi	Bismuth	71,10	**G**	Glucinum	26,54	**N**	Nitrogen	14,00	**Te**	Tellurium	64,25
B	Boron	10,91	**Au**	Gold (Aurum)	199,21	**Os**	Osmium	99,72	**Th**	Thorinm	59,83
Br	Bromine	78,39	**H**	Hydrogen	1,0	**O**	Oxygen	8,01	**Sn**	Tin (Stannum)	58,92
Cd	Cadmium	55,83	**I**	Iodine	126,6	**Pd**	Palladium	53,36	**Ti**	Titanium	24,33
Ca	Calcium	20,52	**Ir**	Iridium	98,84	**P**	Phosphorus	31,44	**W**	Tungsten (Wolfram)	94,80
C	Carbon	6,08	**Fe**	Iron (Ferrum)	27,18	**Pl**	Platinum	98,84	**V**	Vanadium	68,66
Ce	Cerium	46,05	**Ln**	Lanthanum		**K**	Potassium (Kalium)	39,26	**U**	Uranium	217,26
Cl	Chlorine	35,47	**Pb**	Lead (Plumbum)	103.73	**R**	Rhodium	52,2	**Y**	Yttrium	32,25
Ch	Chromium	28.19	**Li**	Lithium	6,44	**Se**	Selenium	39,63	**Zn**	Zinc	32,31
Co	Cobalt	29,57	**Mg**	Magnesium	12,69	**Si**	Silicon	22,22	**Zr**	Zirconium	33,67

BLOWPIPE ANALYSIS.

There are two parts of the Blow-pipe Flame which have distinct properties—1st. The point of *Reduction* at R,—2nd. The point of *Oxidation* at O, The hottest part of the flame is between these two at H.



The **Supports** generally used are, 1st, a little pair of *forceps*, F—2nd, a small piece of *foil*—3rd, A bit of *wire* bent into the shape at W, all of platinum—4th, A small glass tube, one-sixth of an inch in diameter, either open at both or closed at one end. 5th, a piece of charcoal C with a small hole in it, to serve as a sort of Capsule, mounted, as in the figure, on a thin slip of *tin*, one end of which is bent, so as to clasp the charcoal with a spring.

The chief **Fluxes** are $NaO+CO_2$ which is *Alkaline*, the CO_2 being replaced by the acid of the substance employed. Microcosmic Salt or NaO, NH_3+PO_5, which is *acid*, the NH being driven off leaves excess of acid. Borax or $NaO+BO_3$, which is *neutral*.

General Directions.

1st. When a substance is examined for a *colored flame* it must be moistened with its *proper* solvent, that is, SrCl, with HO and $SrO+CO_2$, with HCl.

2nd. When a substance in powder is examined with a *Flux* on C, it must be kneaded into a stiff paste, with a drop of water, when it is in a lump the paste flux is to be spread over it.

3rd. When a substance is examined to color a bead, moisten the platinum wire W, dip it into the Flux and fuse this to a clear bead, then add the smallest portion of the substance.—As Microcosmic Salt from its ready fusibility easily falls from a ring, it is generally fused on C.

4th. When a substance is examined in a closed tube for a sublimate, it must be first intimately mixed with the Flux in powder and introduced by a little shute of paper, so as not to dirty the sides of the tube.

5th. Test Papers must be moistened before use.

6th. A *Cupel* is made by kneading some *fine bone ashes* into a paste, with a little $NaO+CO$, and water, and lining the little capsule in the C with it, the hole may be filled with the paste and shaped with the round end of a small pestle. In this Cupel the alloyed metal is long exposed to the O flame, the oxidizable metals sink into the *Cupel*, leaving a bead of gold or silver, which are the only metals that can be obtained in beads by this process. The Lead of Commerce, thus treated, generally yields a bead of silver.

7th In reducing Metallic Oxides with NaO it is necessary to apply the R flame for a long time over the assay until it sinks into the C, adding fresh NaO if required, the burned portions of the C are then cut out and ground with water in a small mortar—the C floats—the NaO is dissolved and the metal is found at the bottom in a powder or in shining scales.

TABLE I.

Metallic Oxides and Simple Bodies.

Substances	Colored Flames	
KO	**Violet**	Tinges the O flame, a violet of little intensity, and masked by 1-300 part of NaO. To detect KO mixed with NaO add the least particle of $NiO+Ox$ to a bead of Borax, which is turned Brown, then add the suspected salt, and the bead is turned Blue.
NaO	**Yellow**	All the salts of NaO give a long brilliant stream of greenish yellow flame.
NH_3	**NH Gas**	The salts of Ammonia gently heated on platinum with $NaO+CO$ and a drop of water yield NH_3 gas which can be recognised by the smell, or by its forming white fumes with HCl held near it on a glass rod
LiO	**Crimson**	Held at the point of the R flame it communicates a strong durable crimson red to the outer flame.
BaO	**Green**	Its soluble salts moistened with HO or HCl tinge the outer flame green—its insoluble salts give no color.
SrO	**Crimson**	Its soluble salts tinge the outer flame crimson as long as they are fusing.
		The soluble salts of Ca produce a similarly colored flame—perhaps not quite so bright. Pure Ca and $CaO+CO$, when heated to incandescence,

MnO	Gn. & Amyth.	Ignite a small portion of MnO with Borax on platinum foil or wire, it communicates a green color to the bead. Heated on C with Borax or Mic-Salt, the bead acquires an amythest color.
AlO	Blue & Violet	Ignite a small quantity on C, moisten with $CoO+NO_5$ and the mass aequires, by day, a fine blue, and by night, a dirty violet color. AlO becomes incandescent and emits an intense light.
ZnO	Green	Heated on C, with NaO in the inner flame, the Zn salts spread a white coat of oxide around. and moistened with $CoO+NO_5$ they assume a fine green color.
CoO	Blue	The smallest portion colors Mic-Salt and Borax strongly Blue, if too much is used, Black. By NaO on C the CoO Salts are reduced to a grey metal. powd
NiO	Reddish	In the O flame the Salts of NiO give a reddish color to the beads of Mic-Salt or Borax, which color disappears as the bead cools. By NaO on C they are reduced to a white metallic magnetic powder.
FeO	Red & Green	In the O flame the Salts of FeO give, with Borax on C, a deep red colored Bead, which becomes lighter on cooling. In the R flame they give a green bead, the color totally disappearing when cold—fused with NaO they are reduced, yielding a magnetic metallic powder.
CdO	Brn. Powder	Heated on C with NaO in the inner flame, the Salts of CdO bedeck the C with a brownish red powder.
PbO	Light Blue	The Salts of PbO give a pale clear Blue to the O flame—mixed with NaO on C they are reduced to a metallic globule which flattens under the hammer
BiO	———	The Salts of BiO are reduced by NaO on C, producing a brittle bead of metal and coating the C with a yellow powder
CuO	Green	The Salts of CuO give to beads of Mic-Salt and Borax a fine green color in the O flame, and a dirty red in the inner flame—a bit of tin foil assists this last—they are reduced by NaO to a metallic state.
AgO	———	The Salts of AgO easily fuse with NaO and are then reduced to a metallic globule.
HgO	———	In a close tube, with NaO, mercury is sublimed from its compounds and deposited as a grey powder in the tube neck.
PlO	———	Before the Blow-pipe the compounds of Pl are compleatly reduced and give no colored beads.
AuO	———	———,,——— ———,,———
SnO	Red Brown	Reduced easily by NaO to a metallic bead, which flattens under the hammer—these Salts deprive a bead of Mic-Salt and Cu of its green color, rendering it of a reddish brown.
Sb	———	Reduced by NaO to a metallic bead, which is long cooling, gives off a thick smoke, and is, when cold, covered with a net-work of fine crystals.
ChO	Green	The Salts of ChO give a beautiful emerald green to beads of Mic-Salt and Borax, both in the O and R flames.
AsO	Sublimate	In a close tube, with Carb. Soda or Black Flux, metallic As is sublimed, on breaking off the bulb of the tube, and then heating the metal in an open tube, minute octohedrons of AsO will be sublimed on the cooler portions of the glass.
Cl	Bright Blue	Heated on thin brass or copper wire, with a bead of Mic-Salt, the clorides give a brilliant blue flame.
I	Emerald Gn.	——,,—— ——,,—— ——,,—— ——,,—— Iodides ,, an intense emerald green flame.
Br	Blue & Green	——,,—— ——,,—— ——,,—— ——,,—— Bromides ,, a bright blue flame with emerald green edges.
S	Sublimate	Is sublimed from a close glass tube in drops, red while hot, and yellow when cold, from substances containing it in mechanical mixture, and from many metallic sulphurets.
Se	——,,——	Sublimed under circumstances similar to S, the sublimate; if small, is reddish, if large, black, and smells like horse reddish.
F	———	With a metal, see operation 5th, Table V.
Bo	———	As Boracic Acid—see operation 6th, Table V.
P	———	As Phosphoric Acid, see ,, 9th, ,,
Si	———	As Silicic Acid, see note to Table VI.

BLOWPIPE ANALYSIS.

Performed by heating the substance in a small glass tube, closed at one end.

TABLE II.

			Examples for Practice.
Organic Bodies	Char, turn black and deflagrate in red hot nitre.	*ANIMAL* yield vapours of NH_3 which brown moist turmeric paper. *VEGETABLE* yields an acid that reddens blue litmus paper.	Grain of Cochineal Bit of Paper
Volatile Acids	Are given off by salts, having them in excess,	Blue Litmus Paper is reddened, at the tube neck	**K0+2 S0$_3$**
	,, ,, by some neutral nitrates,	Brownish fumes of NO_4	**Pb0+N0$_5$**
	,, ,, by Hyposulphites, which yields SO_2	Bleach moist Brazil paper	**Na0+S0$_2$**
	,, ,, by *Hydrated* Fluorides which yield HF	Turns Brazil paper yellow, but requires a german tube and an intense heat	**Ca+F**
	,, ,, by Oxalates of fixed alkalies and earths which yield CO_2 which	Burns with blue flame at mouth of tube,	**Ca0+$\overline{0}$x**
	,, ,, by other oxalates which yield CO^2	The fixed Carbonate remaining, is generally blackened with adhering C	**Pb0+$\overline{0}$x**
	,, ,, by Cyanides, except dry Cyanides of the Alkalies, Metals, and Earths, which yield N and sometimes NC2 and NH	Ag+Cy and Hg+Cy are exceptions, they give off Cyanogen Gas, which burns with a puce light,	**Ag+Cy** **Hg+Cy**
	Oxalic Acid volatizes undecomposed 3		**0x**
Sulphur	Is sublimed from substances containing it in mechanical mixture, and from many metallic sulphurets,	Sublimes in drops—reddish while hot, yellow when cold,	**S or Fe2 S**
Volatile Sulphurets	Sulph. of *MERCURY*	Black, but if rubbed becomes red,	**Hg S**
	Proto S of *ARSNIC* or Realgar } all subl. undecomp.	Crimson drops—*cool* of the *same* color,	**As S**
	Sesque do. do. or Orpiment }	Sublime in powder, part yellow, part reddish brown	**As$_2$ S$_3$**
Selenium	Sublimed under similar circumstances to sulphur,	Sublimate, if small, is reddish, if large, is black. Heated, it smells strongly of horse radish,	**K0+Se0$_3$**
	ARSENIC sublimes from the metal and most of its alloys,	Smells like garlic—coats the glass as a mirror—if the closed end of the tube be broken off, it sublimes in octohedral crystals—mixed with twice its weight of Formiate of Soda—the metal is sublimed from all its compounds,	**As**

Volatile Metals		Mixed with Formate of Soda the metal sublimes from all its compounds,	
	CADMIUM sublimes from some of its alloys,	It produces on C a yellow brown substance of CaO when openly heated on it,	
	TELLURIUM is with difficulty sublimed, and only with a strong red heat,	Deposited in small metallic drops, like of Hg, but solid	
Solid Volatile Oxides & Acids	*ANTIM OXIDE* fuses to a yellow liquid,	Sublimes in shining needles,	Sb_2O_3
	TELLURIUM OXIDE behaves the same way	,, but not in crystals	$BaO+TeO_3$
	ARSENIOUS ACID sublimes very easily	Gives minute microscopic octohedral crystals	As_2O_3
	ARSENIC ACID yields O and Arsenious Acid	——,,—— ——, —— ——,,——	As^2O_5
	OSMIC ACID sublimes in white drops and crystal needles	Acts strongly on the eyes	
Volatile Saline Bodies	*AMMONIA SALTS* sublime without remainder, unless they contain a fixed Acid, as P_2O_5 or BO_3 inwhich case they are decomposed, and are detected by smelling or test paper		NH_4Cl / $NaO, NH_3+PO_{2\ 5}$
	Hg Cl at a gentle heat, first *fuses* and then sublimes		$HgCl$
	Hg_2Cl sublimes without fusing	Yellow while hot, white when cold	Hg_2Cl
	Bromides and Iodides of *Hg* behave like Clorides	Red Iodide gives a yellow sublimate	HgI
Nitrates Fluorides Iodides	Mingled with $KO+2\ SO_3$ give off red vapours of NO_4	Peculiar odour, deflagrates on C	$KO+NO_5$
	disengage Hydrofluorie Acid	[paper Corrodes the bulb of the tube and whitens brazil	CaF
	disengage Iodine in vapours	Violet color	KI or PbI
Sulphates of Reducible Metals	Dry and mix the sulphate with powdered C it disengages sulphureous acid	Bleaches Brazill Paper	$CuO+SO_3$ / $PbO+SO_3$
Most Metal. Oxides The Arsenites Nit. & Cl Silver Hg Salts of Pb ,, Sb ,,	Mixed with $NaO+\overline{Fo}$ Are all redueed		$As_2O_3\ CuO$ / $Ag+As_2O_3$ / $Ag\ Cl$
		Hg sublimed	$HgCl$ & Hg_2Cl
			$PbO+NO_5$ / Sb_2O_3

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		s.	d.
	APPLICATION OF HEAT.		
A 1	Stoneware Spirit Lamp, with cover and wick holder	1	-
A 2	Cylinder for ditto, serving as a chimney to steady the flame, and as a support for vessels over it	-	9
A 3	5 inch and 3 inch Ring Tops for ditto, to contract orifice for the support of flasks, &c. of various sizes,.. .. .. each	-	5
A 4	Dome to cover flasks when boiling, and prevent the radiation of heat, ... each	-	4
A 5	Sand Bath, $4\frac{1}{2}$ inches, adapted to top of cylinder A 2	-	6
A 6	Dome to cover retorts in distillation	-	6
A 7	Water Bath, $4\frac{1}{2}$ inch diam., for drying powders at a steam heat, adapted to cylinder A 2, in two pieces—boiler and capsule..	-	10
A 8	Oil Lamp for this apparatus, with wick holder	1	0
A 9	Set of 3 plain Cylinders, to lengthen A 2 if necessary, .. each	-	5
A 10	Still or Stoppered Retort for distillation, 16 oz.	1	2
A 11	Flask with round thin bottom and wide mouth, 6 oz. to 8 oz...	-	5
A 12	The total cost of the above 14 articles, forming a complete LAMP FURNACE, is	8	7
A 13	Glass Spirit Lamp, with Brass cap	2	-
A 14	„ „ „ Glass cap	3	6
A 15	Large Spirit Lamp, with circular wick of japanned tin plate and iron chimney, with the improvements of Berzelius, Mitscherlich, and Liebeg	12	-
	VESSELS FOR EVAPORATION, &c. &c.		
	Berlin Porcelain Capsules, with spreading edge glazed :		
B 1	$2\frac{3}{4}$ inches in diameter .. .. each	-	8
B 2	$3\frac{1}{2}$ „ „ .. .. „	-	11
B 3	4 „ „ .. .. „	1	6
B 4	6 „ „ .. .. „	2	6
B 5	$8\frac{1}{2}$ „ „ .. .. „	4	4

VESSELS FOR EVAPORATION—continued.

		s.	d.
	Stoneware Capsules, glazed, very thin:		
B 6	$2\frac{1}{2}$ inches in diameter .. .. each	-	2
B 7	$3\frac{1}{2}$ „ „ .. .. „	-	3
B 8	$4\frac{1}{2}$ „ „ .. .. „	-	5
B 9	6 „ „ .. .. „	-	7
B 10	8 „ „ .. .. „	-	10
B 11	10 „ „ .. .. „	1	2
B 12	Berlin Porcelain Capsule, with handle and spout in one ..	1	-
	„ „ Crucibles, glazed, conical form, with covers:		
B 13	$1\frac{1}{4}$ inch high by $1\frac{3}{4}$ inch wide	-	10
B 14	$1\frac{1}{2}$ „ „ $2\frac{1}{4}$ „	1	4
	Berlin Porcelain Cups, serving as small Crucibles:		
B 15	1 inch diameter	-	3
B 16	$1\frac{1}{2}$ „ „	-	4
B 17	Hessian Crucibles .. .. from 1d. to	-	6
B 18	Black Lead Crucibles, 3 inches high	-	5

FOR GASES.

C 1	Small Woulf's Bottle, with 2 necks	2	-
C 2	Bent Gas Delivery Tubes, ... from 3d. to	-	6
C 3	Circular Stoneware Pneumatic Trough, 11 inches by 5, with Beehive shelf for supporting Jars	2	6
C 4	Beehive Shelf alone	-	8
C 5	Handsome Stoneware Mercurial Trough	4	-
C 6	Stoneware Trays for removing Jars from the Trough when filled with Gas .. .. each	-	2
C 7	Tin Gasometre, 2 gallons	10	-

TESTING AND FILTERING.

	German Glass Tubes, sealed at one end:		
D 1	2 inches long, $\frac{5}{8}$ inches wide .. .. .. per dozen	2	-
D 2	3 „ $\frac{1}{2}$ „ .. .. „	2	6
D 3	4 „ $\frac{1}{2}$ „ .. .. „	3	0
D 4	5 „ $\frac{5}{8}$ „ .. .. „	3	6
D 5	6 „ $\frac{7}{8}$ „ .. .. „	4	6
D 6	Conical Test Glasses, with stalk and lip .. .. .. each	-	9
D 7	Mahogany Frame for 8 large Test Tubes, with pegs	2	-
D 8	White Wood Frame for 6 Test Tubes, without pegs	-	8
D 9	Flint Glass Rod for stirrers, 6 in. long, 1-6 in. wide, per dozen	2	-
D 10	Dropping Tube, with bulb for washing precipitates, &c. ..	1	-
D 11	Tube for Berzelius's Washing Bottle	-	1
D 12	Test Books, containing 50 leaves, bound as a cheque book, viz: Blue Litmus, Red Litmus, Turmeric, Brazil Wood, Acetate of Lead .. .. each	-	$1\frac{1}{2}$

TESTING AND FILTERING—continued.

		s.	d.
D 13	3 inch Iron, Zinc or Copper Bar for metallic precipitation, each	-	1
D 14	Polished Albata Test Spoon	-	8
	Circular Filters of very pure paper, containing no soluble matter, giving only one part in 238 of ashes, and filtering rapidly, the packet, containing 100 in each :		
D 15	2¼ inches diameter .. .. per 100	-	3
D 16	3¾ „ .. .. „	-	8
D 17	5½ „ .. .. „	1	1
D 18	7½ „ .. .. „	1	6
	Filter Boxes to fit these:		
D 19	2¼ inches diameter	-	6
D 20	3¾ „	-	8
D 21	5½ „	-	9
D 22	7½ „	1	3
D 23	Closed Tubes, for the sublimation of Arsenic with Bulb, each	-	1
D 24	Open ditto, for ditto, ... „	-	1
D 25	Hard German Glass, tubes same size .. .. .. „	-	2
D 26	Small Boxes, containing Copper Zinc and Iron Bar, together with 4 books Test Paper, and Starched Cotton, as a test for Iodine	-	10
D 27	Starched Cotton, a test for Iodine .. .. per yard	-	1

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BLOWPIPE.

E 1	Japan Tin Blowpipe, with moveable brass pipe and brass nozzle	1	-
E 2	Charcoal Borer, to prepare Charcoal for supporting Assays ..	-	4
E 3	Iron Forceps, with platinum points	2	6
E 4	Platinum Foil, in slips, 2 inches by ½ inch .. .. each	-	8
E 5	Platinum Wire, 2 inches long	-	3
E 6	Plain Jeweller's Blowpipe, 8 inch	-	9
E 7	Steel Tongs, for Table Blowpipe	1	4
E 8	Fine Copper and Brass Wire .. .. .. per yard	-	1
E 9	Tin Foil, 9 square inches	-	1
E 10	Tin Plate Charcoal Holder	-	1

SUNDRIES.

F 1	Retort Stand, with triangular support	1	6
F 2	Retort Stand, with 3 circular moveable rings, brass mounted ..	4	-
F 3	China Funnel Holder, with rod and foot	2	3
F 4	Tube Holder, with rod and foot	1	6
F 5	Florence Flasks .. .. per dozen	1	-
F 6	Glass Retorts .. .. from	-	8

	SUNDRIES—continued.	s.	d.
F 7	6 inch German Glass Boiling Tube	-	5
F 8	Caoutchouc, in sheets, 25 square inches	-	6
F 9	Deflagrating Ladle, iron	-	3
F 10	Brass Stop Cocks, male and female .. .. each	2	2
F 11	„ Connectors, „ .. .. „	-	8
F 12	„ Jets	2	-
F 13	2 oz. Leaden Bottle, for Fluoric Acid	1	2
F 14	Crucible Tongs	1	6
F 15	Iron Retorts	4	-
F 16	Small Porcelain Mortar, with Pestle	1	3
F 17	Flexible Metal Pipe .. .. per foot	-	4
F 18	Clark's Filtering Ring, 1 inch, glazed china	-	4
F 19	Horse-shoe Magnets, with keeper	1	3
F 20	Flint Glass Tubing .. .. per oz.	-	2
F 21	„ „ very fine .. .. „	-	3

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	No. I.—Griffin's Mineral Cabinet, comprising 50 specimens of Minerals, and 50 specimens of Rocks; size, two square inches (with 15 models of Crystals); affording the means of forming a practical acquaintance with the kindred sciences of Mineralogy, Geology, and Crystallography. Size of the Cabinet, 12 by 10 inches, and 8 inches deep. Price .. This Cabinet is intended for persons who may be reading Elementary Works on Mineralogy, or attending popular Lectures on that Science.	45	-
	Outlines of Mineralogy, Geology, and Crystallography, and an exact description of the hundred Rocks and Minerals contained in "Griffin's Mineral Cabinet." 12mo, sewed and gilt. Price	1	-
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